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A Chemical Service for India.

THE constructive proposals put forward in the Report of the Indian Industrial Commission, 1916–18, presided over by Sir Thomas Holland, were dependent on the acceptance of two principles: (1) That in future Government must play an active part in the industrial development of the country, with the aim of making India more self-contained in respect of men and material; (2) that it is impossible for Government to undertake that part unless provided with adequate administrative equipment and fore-armed with trustworthy scientific and technical advice.

The Report under consideration[1] is the work of a Committee which sat in Simla, from February 16 until February 28 of this year, after the president with two members of the Committee had toured through the provinces. The Committee was appointed "to formulate proposals for the organisation of a Chemical Service for India and for the location and equipment of research laboratories."

Prof. J. F. Thorpe, professor of organic chemistry in the Imperial College of Science and Technology, London, was president of the Committee. His associates were Dr. K. S. Caldwell, principal of Patna College; Mr. R. W. Davies, district and sessions judge, North Arcot, Madras Presidency; Dr. W. Harrison, Imperial agricultural chemist, Research Institute, Pusa; Sir P. C. Rây, professor of chemistry, University College of Science, Calcutta; Dr. J. L. Simonsen, forest chemist, Forest Research Institute and College, Dehra Dun; Dr. J. J. Sudborough, professor of organic chemistry, Indian Institute of Science, Bangalore.

The terms of reference to the Committee were:

(1) To consider whether an all-India Chemical Service is the best and most suitable method of overcoming the difficulties and deficiencies pointed out by the Indian Industrial Commission.

(2) In the event of the Committee approving the principle of an all-India service, to devise terms of recruitment, employment and organisation; to indicate the extent to which chemists already in Government employ should be included in that service; and to suggest what should be the relations of the proposed organisation with the public and with Departments of the Government of India and of Local Governments.

(3) In particular to frame proposals for the location, scope and organisation of institutions for chemical research.

During his tour Prof. Thorpe became satisfied that the development of the chemical industries of India could be adequately realised only through the agency of an efficient Government Chemical Service. Nowhere did he find an effective organisation to co-ordinate the various efforts which were being made; not one of the provinces had even formulated a programme of its requirements or decided what educational methods were necessary to attain the desired ends. To achieve success the proposed Chemical Service must be recruited mainly from Indian sources: the question of an adequate training in Indian universities is therefore vital. This subject is specially dealt with by Prof. Thorpe in an able introductory note: the Committee expresses itself as in agreement with his views.

The evidence put before the Committee was so definitely in favour of a Chemical Service that it came to the conclusion that question No. 1 of its remit, quoted above, could be best answered by the formation of a service having as its primary objective the encouragement of industrial research and development.

The Committee makes thirty-five recommendations of which the first twelve are as follows:—

(1) That a Chemical Service should be constituted.

(2) That the service should be called the Indian Chemical Service.

(3) That the service should be controlled by a Director-General.

(4) That a Central Imperial Chemical Research Institute should be erected at Dehra Dun under the Director-General of the Chemical Service, as Director, assisted by a number of Deputy Directors.

(5) That each Deputy Director should be in charge of a separate Department and that, in the first instance, there should be four Departments, (*a*) Inorganic and Physical Chemistry, (*b*) Organic Chemistry, (*c*) Metallurgical Chemistry, (*d*) Analytical Chemistry.

(6) That a Provincial Research Institute under

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[1] Report of the Chemical Services Committee, 1920. (Simla: Government Central Press.)

the control of the Local Government should be erected in each province near the chief seat of industry in that province and that each Provincial Research Institute should be under a Director of Research.

(7) That the functions of the Central Imperial Institute should be as follows:—

(*i*) to create new industries and to carry out the development of new processes up to the "semi-large" scale or further if necessary,
(*ii*) to investigate those problems of a fundamental character, arising from the work of the Provincial Institutes, which have been transferred to the Central Institute by the Local Director of Research in consultation with the Director-General. Such problems will be those which have no apparent immediate practical importance but which, in the opinion of the Director-General and the Director of Research, are likely to lead to discoveries of fundamental industrial importance affecting the industries of the country generally,
(*iii*) to assist in the co-ordination of the work in progress in the provinces: both by means of personal discussion between the officers of the Central and Provincial Institutes during the course of the tours made by the Director-General and the Deputy Directors and by means of periodical conferences of Provincial and Imperial officers,
(*iv*) to carry out such analytical work as may be required and to correlate the methods of analysis in general use throughout the country,
(*v*) to maintain a Bureau of Information and Record Office,
(*vi*) to issue such publications as are considered necessary.

(8) That the functions of the Provincial Research Institutes should be as follows:—

(*i*) to maintain close touch with the works chemists and with the works generally and to work out any problems which may be submitted to them,
(*ii*) to develop and place on an industrial scale new industries which have been previously worked out on the laboratory and "semi-large" scale by the Central Imperial Institute,
(*iii*) to carry out such other work as may be necessary to establish and foster new industries peculiar to the province,
(*iv*) to carry out such analytical work of a chemical character as may be required in the province,
(*v*) to erect and control sub-stations in such parts of the province as the development of industry may require.

(9) That, under (8) (*i*) above, arrangements should be made by which a firm supplying a problem should have the use of the solution for an agreed period of time prior to its publication.

(10) That members of the service should be lent to private firms as occasion demanded and should during the period of their service be paid an agreed sum by the firms.

(11) That the Research Institutes should not undertake manufacture in competition with private enterprise but that chemical industries developed in accordance with (8) (*ii*) above should be handed over to private firms as soon as practicable.

(12) That, whenever necessary, experts should be employed to establish chemical industries based on known processes.

Among the other recommendations are that agricultural chemists should not at present be included in the service; that a Ministry of Science should be created as soon as practicable; that a Chemical Survey of India should be carried out at the earliest possible moment; and that the Government of India should give maintenance and equipment grants to students, to enable them to undergo the training in chemical research required for recruitment.

It is not a little remarkable that the only member of the Committee to take exception to the creation of an all-India Chemical Service is the one Indian member, Sir P. C. Rây. A separate note is appended to the Report in which he forcibly states his objections. Sir P. C. Rây's opinion must carry great weight, not only on account of his long experience and his distinction as a teacher and investigator but also because of his familiarity with industrial requirements and possibilities, he having long been concerned with the management of a chemical works which he was instrumental in establishing. The present writer had the opportunity of visiting this works when in Calcutta in November, 1914, and was much struck by the ingenuity displayed in the construction of the plant; various heavy chemicals were being made, including sulphuric acid, in substantial quantities.

Although Sir P. C. Rây considers that the days of Government services are over and that the development of industries by the agency of a Government service is not the most suitable way of dealing with the problem, yet he agrees that, if a Government service be constituted, the proposals of the Committee represent the best method of constituting and carrying on such a service. His view is that better results would be obtained by improving the teaching of chemistry in the Indian universities; by attracting brilliant young men by the offer of research scholarships; and by attaching technical institutes to each university.

The circumstances of India are so entirely peculiar that it is impossible to judge the scheme from an ordinary point of view. A number of those who contributed to the recent correspondence in NATURE appear to fear that the liberty of the subject engaged in research work may be improperly interfered with and curtailed by the institution of a separate Chemical Service. This should not be the case. It is to be supposed that the studies undertaken will be strictly utilitarian in character—the primary objective being the encouragement of "industrial research" and to secure the co-operation of science and industry. The fact is, the term "research" were better put aside altogether in the present connection—it now has so many meanings, if any meaning in particular: it should be confined to strictly original inquiry and regarded as a word of sacred import. Organised scientific inquiry into industrial problems is what is aimed at by the promoters of the scheme: therefore Central Scientific Institute would be a better title than Central Research Institute, "Research" being a word unknown to the multitude and one for which it never can have any feeling.

India is a country of vast size and is broken up into an infinitude of small holdings: its problems are more than numerous: the nature and extent of its raw materials must be surveyed without loss of time: very little has been done to develop industries. The one crying need seems to be an organisation of effort. A service is required if only in protection of the workers.

Perhaps the chief objection to be taken to the scheme is its magnitude and therefore its costliness; it involves the simultaneous establishment of so many district institutes, to satisfy the desire of the several provinces to exercise administrative control in their own areas. The real difficulty will be to find men who are competent to act as directors—men who are not only technically competent but also sufficiently imaginative and broad in outlook, *able to hold their own socially* and to manage men. Such men have been in constant demand here of late and too rarely forthcoming. Indeed, the complaint is frequent that, though those entering technical careers may be chemists by training, they lack initiative and are unable to shoulder responsibility. Science does not at present attract the right type of intelligence to its ranks. Do not let us delude ourselves into thinking that we can repair our past errors and become a scientific nation at will—by admitting large numbers to the schools and creating numerous new posts: without acumen and experience, nothing can be done. The success of the Indian scheme will depend largely on the man first chosen to fill the post of Director of the Central Institute: he must be gifted with a liberal spirit and with ideas; his time must not be unduly taken up in attending to administrative details; he must himself be a skilled scientific worker. Only such a man will be able to assist the work of the universities and be a generous and capable critic of the men they educate for the purposes of industry and the State service.

Sir P. C. Rây would in all cases start industries by means of technical experts imported from abroad and would not attempt to work them up locally with the aid of the Research Institutes, as proposed by the Committee. He is unquestionably right in so far as large industries, well established elsewhere, are concerned; and as a matter of fact the Committee advises that this course should be taken in all such cases. The proposals of the Committee apply specially to small-scale industries in which it is desirable to encourage native activity; the work done by Sir Alfred Chatterton in Madras in developing the use of aluminium may be quoted in illustration. The Indian is eminently conservative and is not easily persuaded to do new things—but he can often be led by ocular demonstrations; it will be the function of the provincial institutes to give these.

In its reference to the exploitation of forest products, the Committee mentions match-making as an industry which it understands the Forest Department has under contemplation and seems to give its approval. Here Sir P. C. Rây's criticism is to the point. Match-making is so thoroughly understood that it seems undesirable that academic workers should take it in hand: in such a case, it were better at once to call in the expert. The suitability of various fibres for paper-making is quite another question: it is clearly desirable that these should be first tested on the spot, so that the many variations to which the raw material would be subject could be taken into account.

The great value of the Report lies in the recommendation of an all-India scientific service—the directions in which the service can be made of most avail will be gradually discovered as the service comes into operation. That the industrial future of India can be secured only with the aid of the scientific inquirer and by placing industry on a scientific footing is beyond all question. Thanks are due to Prof. Thorpe and his colleagues for the able way in which they have dealt with their onerous task.

Mr. Howard, Imperial economic botanist to the Government of India, directed attention recently, at the Royal Society of Arts, to the future of economic botany in India and to the many complex problems awaiting solution: after asking what is the best method of getting such work done—whether we should rely on organisation or trust to the individual—he expressed the opinion that individual action is to be preferred. But surely the competent individual should be able to influence a receptive though unimaginative multitude. Increase in knowledge is of little value if it do not give us an increase of power to use our knowledge—we know that it does. During the war, much organised team work was accomplished by scientifically trained workers under the influence of a few guiding minds. The men who are doing research work in the various schools are for the most part unconscious members of a service acting under the inspiration of a few leaders: there is no reason why the system should not be carried from academic life into the public service. We are alive to the faults by which a public system is likely to be affected and should be able to guard against them. HENRY E. ARMSTRONG.

Tycho Brahe.

Tychonis Brahe Dani Opera Omnia. Edidit I. L. E. Dreyer. Tomus vi. Pp. v+375. (Hauniæ: Libraria Gyldendaliana, 1919.) Price 19 kr.

MR. HAGEMANN, who is bearing the expense, and Dr. Dreyer, who has undertaken the labour of editing the works of Tycho Brahe, are alike to be congratulated on the appearance of this elegant edition of the first book—the only one ever published—of the "Epistolæ Astronomicæ." The frontispiece consists of a handsome portrait of Tycho Brahe, dated 1586, reproduced from the first edition, which appeared in 1596. Here the portrait is enclosed in an arch ornamented with sixteen coats-of-arms, either, we may conjecture, his sixteen quarterings, or at least the arms of his own and fifteen kindred families. The English reader will note with special interest the arms of Rosenkrans and Guldensteren, and we have not far to seek for bearers of those arms. In Dr. Dreyer's "Tycho Brahe" (1890) Jörgen Rosenkrands is frequently mentioned as a patron of Tycho. He was Governor of Jutland, and in 1588 was made one of the Council of Regency for the young King Christian IV. of Denmark. Axel Guldenstern appears in two letters in the present volume dated 1592, where he is described as a kinsman of Tycho and Governor of Norway.

The letters contained in the present volume range in date from 1585 to 1595. They comprise the correspondence of Tycho Brahe with Wilhelm, Landgrave of Hesse-Cassel, his son and successor Moritz, and his "mathematicus" Rothmann. The letters are partly in Latin and partly in German, but the German letters are always accompanied by a Latin translation. Their contents are well exploited in Dr. Dreyer's "Tycho Brahe," mentioned above, and in his "History of the Planetary Systems" (1906). Perhaps the most generally interesting part of the present collection is the description of Tycho's observatory at Hveen and of his instruments, which occupies pp. 250–95 of this volume. Tycho's attitude to astronomy and astronomers is well illustrated by the selection of eight, whose portraits adorned the crypt of his observatory—Timocharis, Hipparchus, Ptolemy, Albategnius, Alfonso, Copernicus, Tycho Brahe, and Tychonides, with the pithy distichs in which Tycho sums up the importance of each (pp. 274, 275).

The correspondence with Rothmann will remain famous for the clearness with which Rothmann grasped the implications of the Copernican system, and maintained them against Tycho's futile objections, which, to men brought up to believe in a stationary earth, appeared so cogent. It is somewhat pathetic that this record of the ancient controversy should have appeared only a few weeks before the triumphant vindication of a new theory which renders the difference between Copernicus and Tycho meaningless.

Tycho was the first of modern astronomers to make more than occasional observations, and it was therefore natural that the work of the ancient observers, particularly Timocharis, Hipparchus, and Ptolemy, should possess a living interest for him and his correspondents instead of having, as to nearly all modern astronomers, a purely antiquarian importance. Rothmann (p. 115) made one unhappy suggestion about Ptolemy which can scarcely have been intended for publication. Certainly the author can never have dreamed of the way in which it was to be extended. The suggestion is that the places of the fixed stars in Ptolemy were not observed by him, but merely transcribed from Hipparchus. Rothmann shows, quite correctly, that the latitude which Ptolemy professes to have observed for Regulus is inconsistent with the longitude and declination which he also professes to have observed; his own observations, he says, are not inconsistent with